

AMENDMENTS TO THE CLAIMS

1. (Original) A process for depositing a metal structure on a surface of a workpiece defining a plurality of recessed microstructures, comprising:

(a) exposing the surface of the workpiece to an electroplating bath including a source of metal ions to be deposited on the surface and an organic additive that influences the metal ions to be preferentially deposited within the recessed microstructures relative to the surrounding surface;

(b) supplying net forward electroplating power between the exposed surface of the workpiece and an anode disposed in electrical contact with the electroplating bath for a first time period selected so that metal ions are deposited on the surface; and

(c) reversing the electroplating power supplied between the anode and the exposed surface of the workpiece for at least a portion of a second time period selected to control the deposition of further metal ions over the recessed microstructures relative to the surrounding surface.

2. (Original) The process of Claim 1, wherein the first time period and a level of forward electroplating power supplied during the first time period are selected such that metal ions are deposited within the recessed microstructures to nominally fill the recessed microstructures during the first time period, and the second time period and a level of reverse electroplating power supplied during the second time period are selected to ameliorate deposition of an overburden of metal ions over the recessed microstructures relative to the remainder of the surface.

3. (Original) The process of Claim 1, wherein during the second time period the power that is supplied between the anode and the exposed surface of the workpiece is alternated between pulses of forward power interspersed with pulses of reverse power.

4. (Original) The process of Claim 3, wherein the duration of each pulse of reverse power is greater than 1 millisecond.
5. (Original) The process of Claim 4, wherein the duration of each pulse of reverse power is greater than or equal to 10 milliseconds.
6. (Original) The process of Claim 3, wherein the second time period is greater than or equal to 10 seconds.
7. (Original) The process of Claim 6 wherein the second time period is greater than or equal to 60 seconds.
8. (Original) The process of Claim 1, wherein the reverse electroplating power is sustained for the duration of the second time period, further comprising supplying electroplating power between the exposed surface of the workpiece and the anode for a third time period before or after the second time period during which third period forward and reverse electroplating power is supplied in a series of interspersed pulses.
9. (Original) The process of Claim 8, wherein the second time period during which reverse electroplating power is supplied is greater than or equal to 1 second.
10. (Original) The process of Claim 9, wherein the reverse electroplating power is supplied for a second time period of greater than or equal to 5 seconds.
11. (Original) The process of Claim 1, wherein the reverse electroplating power is supplied at a reverse current of absolute magnitude greater than 1 amp.
12. (Original) The process of Claim 1, wherein the reverse electroplating power is supplied at a voltage potential of absolute magnitude greater than 0.05 volts.
13. (Original) The process of Claim 1, wherein the metal that is deposited comprises copper.
14. (Original) The process of Claim 13, wherein the source of metal ions comprises copper sulfate.

15. (Original) The process of Claim 14, wherein the electroplating bath further comprises a source of chlorine ions.

16. (Original) The process of Claim 1, wherein the organic additive comprises an accelerator agent.

17. (Original) The process of Claim 16, wherein the accelerator agent includes the chemical structure S-R₁-S, wherein R₁ comprises an alkyl or an aryl group.

18. (Original) The process of Claim 1, wherein the organic additive comprises a suppressor agent.

19. (Original) The process of Claim 18, wherein the suppressor agent comprises a compound including the chemical structure N-R₁-S, wherein R₁ comprises an alkyl or an aryl group.

20. (Original) The process of Claim 1, wherein the organic additive comprises a leveler agent.

21. (Original) The process of Claim 20, wherein the leveler agent comprises a polyethylene glycol or polyoxyethylene glycol.

22. (Original) The process of Claim 1, further comprising supplying forward electroplating power between the surface of the workpiece and the anode for a third time period after the second time period.

23. (Canceled)

24. (Original) A process for depositing a metal structure on a surface of a workpiece defining a plurality of recessed microstructures, comprising:

(a) exposing the surface of the workpiece to an electroplating bath including a source of metal ions to be deposited on the surface and an organic additive that is absorbed on the surface and influences the metal ions to be preferentially deposited within the recessed microstructures relative to the remainder of the surface;

(b) supplying net forward electroplating power between the exposed surface of the workpiece and an anode disposed in electrical contact with the electroplating bath for a first time period and at a first level of supplied power selected so that metal ions are deposited to nominally fill the recessed microstructures; and

(c) reversing the electroplating power supplied between the anode and the exposed surface of the workpiece during at least a portion of a second time period and at a second level of applied power selected to limit the deposition of further metal ions over the nominally filled recessed microstructures relative to the remainder of the surface to desorb the organic additives to ameliorate the development of an overburden of metal over the recessed microstructures.

25. (Original) A process for depositing a metal structure on a surface of a workpiece defining a plurality of recessed microstructures, comprising:

(a) exposing the surface of the workpiece to an electroplating bath including a source of metal ions to be deposited on the surface;

(b) supplying net forward electroplating power between the exposed surface of the workpiece and an anode disposed in electrical contact with the electroplating bath for a first period of time and under a first set of plating process parameters such that metal ions are preferentially deposited within the recessed microstructures relative to the remainder of the surface; and

(c) supplying electroplating power between the anode and the exposed surface of the workpiece during a second time period in a series of forward plating power pulses interspersed with reverse plating power pulses to control the deposition of further metal ions over the recessed microstructures relative to the remainder of the surface.

26. (Original) A process for depositing a metal structure on a surface of a workpiece defining a plurality of recessed microstructures, comprising:

(a) exposing the surface of the workpiece to an electroplating bath including a source of copper ions, an acid, a source of chlorine ions and an organic additive that influences the metal ions to be preferentially deposited within the recessed microstructures relative to the remainder of the surface;

(b) supplying net forward electroplating power between the exposed surface of the workpiece and an anode disposed in electrical contact with the electroplating bath for a first period of time and at a first level of supplied power such that metal ions are preferentially deposited within the recessed microstructures relative to the remainder of the surface; and

(c) supplying electroplating power between the anode and the exposed surface of the workpiece during a second time period in a series of forward plating power pulses interspersed with reverse plating power pulses to control the deposition of further metal ions over the recessed microstructures relative to the remainder of the surface.

27. (Canceled)

28. (Original) An electroplating apparatus for applying a metal structure to a surface of a workpiece defining a plurality of recessed microstructures, comprising:

(a) a reactor for receiving the surface of the workpiece and exposing the surface to an electroplating bath including a source of metal ions and an organic additive that influences the metal ions to be preferentially deposited within the recessed microstructures relative to the remainder of the surface;

(b) an anode in electrical contact with the electroplating bath;

(c) a power supply for supplying electroplating power between the surface of the workpiece and the anode to electroplate the metal ions onto the surface, the power supply being capable of supplying forward power and reverse power; and

(d) a controller for controlling the power supply to supply net forward electroplating power for a first time period so that the metal ions are deposited on the surface and

for supplying reverse electroplating power for at least a portion of a second time period to control the deposition of further metal ions over the recessed microstructures relative to the remainder of the surface.

29. (Currently amended) The ~~process~~ apparatus of Claim 28, wherein during the second time period the power that is supplied between the anode and the exposed surface of the workpiece is alternated between pulses of forward plating power interspersed with pulses of reverse plating power.

30. (Currently amended) The ~~process~~ apparatus of Claim 28, wherein the controller is operable to control the power supply to supply sustained reverse electroplating power for the duration of the second time period, wherein the controller is further operable to control the power supply to supply electroplating power between the exposed surface of the workpiece and the anode for a third time period during which forward and reverse electroplating power is supplied in a series of interspersed pulses.

31. (Currently amended) The ~~process~~ apparatus of Claim ~~[[1]]~~ 28, wherein the controller is operable to control the power supply to supply forward electroplating power between the surface of the workpiece and the anode for a third time period after the second time period.